Assignment 7.1 Questions 15, 31 – 43 odd

15) energy is directly proportional to frequency and inversely proportional to wavelength. Wavelength and frequency are inversely proportional to each other.

Photon energy = (6.626 x 10^{-34}) x frequency $\Delta E = h f$

Speed of light = frequency x wavelength $c = f \lambda$

Constants and equations will be provided on the test (except speed of light)

31) 3.00 x 10^{8} m/s = f (660 x 10^{-9} m)

f = 4.5 x 10^{14} Hz

33) 3.00 x 10^{8} m/s = f (0.010 m)

f = 3.0 x 10^{10} Hz

$\Delta E = (6.626 \times 10^{-34})(3.0 \times 10^{10})$

$\Delta E = 2.0 \times 10^{-23}$ J/photon

$$\frac{6.022 \times 10^{23} \text{ photons}}{1 \text{ photon}} \left| \frac{2.0 \times 10^{-23} \text{ J}}{} \right. = \textbf{12 J/mol or 12 Einsteins}$$

35) longer wavelength = wave A = 1.6 x 10^{-3} m / 4 = ***4.0 x 10^{-4} m***

higher frequency = wave B

3.00 x 10^{8} m/s = f (2.0 x 10^{-4} m)

f = 1.5 x 10^{12} Hz

$\Delta E = (6.626 \times 10^{-34})(1.5 \times 10^{12})$

$\Delta E = 9.9 \times 10^{-22}$ J/photon

Both travel at the ***speed of light*** and both are ***infrared***.

37) $c = f \lambda$

3.00 x 10^{8} = f (150 x 10^{-9} m)

f = 2.00 x 10^{15} Hz

$E = h f$

$E = (6.626 \times 10^{-34})(2.00 \times 10^{15})$

$E = 1.33 \times 10^{-18}$ J/photon

$$\frac{1.98 \times 10^{5} \text{ J}}{1.33 \times 10^{-18} \text{ J}} \left| \frac{1 \text{ photon}}{1 \text{ photon}} \right| \frac{1 \text{ C atom}}{} = \textbf{1.49 x } \boldsymbol{10^{23}} \textbf{ atoms}$$

39) $$\frac{279.8 \text{ kJ}}{1 \text{ mol Li}} \left| \frac{1000 \text{ J}}{1 \text{ kJ}} \right| \frac{1 \text{ mol Li}}{6.022 \times 10^{23} \text{ atoms}} = 4.646 \times 10^{-19} \text{ J / atom}$$

$\Delta E = h f$

$4.646 \times 10^{-19} = (6.626 \times 10^{-34}) f$

f = 7.012 x 10^{14} Hz

$c = f \lambda$

$2.998 \times 10^{8} = 7.012 \times 10^{14} \lambda$

$\lambda = 4.276 \times 10^{-7}$ m or 427.6 nm

41) a. $\lambda = h/mv$ *(de Broglie's equation)*

$\lambda = (6.626 \times 10^{-34}) / (9.11 \times 10^{-31} \text{ kg})(3.0 \times 10^{7} \text{ m/s})$

$\lambda = 2.4 \times 10^{-11}$ m or 0.024 nm

b. $\lambda = (6.626 \times 10^{-34}) / (0.055 \text{ kg})(35 \text{ m/s})$

$\lambda = 3.4 \times 10^{-34}$ m or 3.4×10^{-25} nm *(too small to ever detect)*

43) $(1.5 \times 10^{-15}) = (6.626 \times 10^{-34}) / m\ (2.7 \times 10^{8})$

m = 1.6 x 10^{-27} kg *(This is the mass of a proton or neutron)*